

What is claimed:

1. A defrostable ventilation apparatus, for exchanging air between the interior and exterior of a building, for transferring water moisture and sensible heat between exhaust air taken from the building and fresh air taken from the exterior ambient air for delivery to the building, and wherein air from the interior of the building is used as defrost air to defrost the ventilation apparatus, said ventilation apparatus having fresh air path means having a fresh air intake side and a fresh air discharge side, exhaust air path means having an exhaust air intake side and an exhaust air discharge side, a rotary exchanger wheel for transfer of water moisture and sensible heat between said exhaust air and said fresh air, said exchanger wheel being configured and rotatably disposed so as to define a first air stream path and a second air stream path, said first air stream path defining a portion of said fresh air path means between the fresh air intake side and the fresh air discharge side thereof and said second air stream path defining a portion of said exhaust air path means between the exhaust air intake side and the exhaust air discharge side thereof, and a ventilation rotation component for inducing, during a ventilation cycle, ventilation rotation of said exchanger wheel through said fresh air path means and said exhaust air path means, characterized in that said apparatus comprises defrost air path means for conveying defrost air to said fresh air intake side, said defrost

air path means being configured to connect the exhaust air discharge side with the fresh air intake side for conveying defrost air to said fresh air intake side from said exhaust air discharge side,

a damper component, said damper component being displaceable between a ventilation configuration for a ventilation cycle

wherein said defrost air path means is closed off and said fresh air intake side and exhaust air discharge side are open,

and a defrost configuration for a defrost cycle

wherein said fresh air intake side and said exhaust air discharge side are closed off and said defrost air path means is open,

and

a defrost rotation component for inducing, during a defrost cycle, said rotary exchanger wheel to rotate at a defrost rotation speed of from 0 to 2 rpm through said fresh air path means and said exhaust air path means,

and wherein

during a ventilation cycle, when said damper component is in said ventilation configuration,

fresh air is able to flow through said fresh air path means and exhaust air is able to flow through said exhaust air path means,

and

during a defrost cycle, when said damper component is in said defrost configuration,

defrost air taken from the building, is able to circulate, for delivery back into the building, through said exhaust air intake side, through said second air stream path, then through said defrost air path means, through said first air stream path,

fresh air is able to flow through said fresh air path means and exhaust air is able to flow through said exhaust air path means,

and

during a defrost cycle, when said first and second damper components are in said respective defrost configurations,

defrost air taken from the building, is able to circulate, for delivery back into the building, through said exhaust air intake side, through said second air stream path, then through said defrost air path means, through said first air stream path, and through said fresh air discharge side.

4. The ventilation apparatus as defined in claim 3

wherein said fresh air path means, said exhaust air path means, said rotary exchanger wheel, and said defrost air path means, are disposed in a cabinet,

wherein said fresh air intake side, said exhaust air discharge side, said fresh air discharge side and said exhaust air intake side each includes one respective air opening in an outer wall of said cabinet,

wherein a partition wall in said cabinet separates said exhaust air discharge side from said fresh air intake side,

and

wherein said defrost air path means comprises an opening in said partition wall.

5. A ventilation apparatus as defined in claim 4 wherein said apparatus includes a fan component mounted in said cabinet for moving fresh air through said fresh air path means and for moving exhaust air through said exhaust air path means, said fan

component comprising one electric motor and two blower wheels operatively connected thereto, said fresh air path means including one said blower wheel and said exhaust path means including the other said blower wheel.

6. A defrostable ventilation apparatus, for exchanging air between the interior and exterior of a building, for transferring water moisture and sensible heat between exhaust air taken from the building and fresh air taken from the exterior ambient air for delivery to the building, and wherein air from the interior of the building is used as defrost air to defrost the ventilation apparatus, said ventilation apparatus having fresh air path means having a fresh air intake side and a fresh air discharge side, exhaust air path means having an exhaust air intake side and an exhaust air discharge side, a rotary exchanger wheel for transfer of water moisture and sensible heat between said exhaust air and said fresh air, said exchanger wheel being configured and rotatably disposed so as to define a first air stream path and a second air stream path, said first air stream path defining a portion of said fresh air path means between the fresh air intake side and the fresh air discharge side thereof and said second air stream path defining a portion of said exhaust air path means between the exhaust air intake side and the exhaust air discharge side thereof, and a ventilation rotation component for inducing, during a ventilation cycle, ventilation rotation of said exchanger wheel through said fresh air path means and said exhaust air path means,

characterized in that said apparatus comprises

defrost air path means for conveying defrost air to said fresh air intake side, said defrost air path means being configured to connect the exhaust air discharge side with the fresh air intake side for conveying defrost air to said fresh air intake side from said exhaust air discharge side,

and

a damper component, said damper component being displaceable between a ventilation configuration for a ventilation cycle

wherein said defrost air path means is closed off and said fresh air intake side and exhaust air discharge side are open,

and a defrost configuration for a defrost cycle

wherein said fresh air intake side and said exhaust air discharge side are closed off, and said defrost air path means is open,

a component for stopping, during a defrost cycle, said rotary exchanger wheel from rotating,

and wherein

during a ventilation cycle, when said damper means is in said ventilation configuration,

fresh air is able to flow through said fresh air path means and exhaust air is able to flow through said exhaust air path means,

and

during a defrost cycle, when said damper means is in said defrost configuration,

defrost air taken from the building, is able to circulate, for delivery back into the building, through said exhaust air intake side, through said second air stream path, then through said defrost air path means, through said first air stream path,

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a defrost configuration

wherein said exhaust air discharge side is closed off,

and wherein

during a ventilation cycle, when said first and second damper components are in said respective ventilation configurations,

fresh air is able to flow through said fresh air path means and exhaust is able to flow through said exhaust air path means,

and

during a defrost cycle, when said first and second damper components are in said respective defrost configurations,

defrost air taken from the building, is able to circulate, for delivery back into the building, through said exhaust air intake side, through said second air stream path, then through said defrost air path means, through said first air stream path, and through said fresh air discharge side, .

10. The ventilation apparatus as defined in claim 9

wherein said fresh air path means, said exhaust air path means, said rotary exchanger wheel, and said defrost air path means, are disposed in a cabinet,

wherein said fresh air intake side, said exhaust air discharge side, said fresh air discharge side and said exhaust air intake side each includes one respective air opening in an outer wall of said cabinet,

wherein a partition wall in said cabinet separates said exhaust air discharge side from said fresh air intake side,

and

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- i) directing exhaust air to flow through said second air path and then through said first air path back into said building, and
- ii) stopping the rotation of said exchanger wheel such that said rotary exchanger wheel is able to be defrosted by said exhaust air.

14. A defrostable ventilation apparatus, for exchanging air between the interior and exterior of a building, for transferring water moisture and sensible heat between exhaust air taken from the building and fresh air taken from the exterior ambient air for delivery to the building, and wherein air from the interior of the building is used as defrost air to defrost the ventilation apparatus, said ventilation apparatus having fresh air path means having a fresh air intake side and a fresh air discharge side, exhaust air path means having an exhaust air intake side and an exhaust air discharge side,

a rotary exchanger wheel for transfer of water moisture and sensible heat between said exhaust air and said fresh air,

said exchanger wheel being configured and rotatably disposed so as to define a first air stream path and a second air stream path,

said first air stream path defining a portion of said fresh air path means between the fresh air intake side and the fresh air discharge side thereof and said second air stream path defining a portion of said exhaust air path means between the exhaust air intake side and the exhaust air discharge side thereof,

and

a rotation component for inducing rotation of said exchanger wheel through said fresh air path means and said exhaust air path means,

characterized in that said apparatus comprises

defrost air path means for providing an air path by-passing said first air stream path, said defrost air path means comprising a defrost air discharge side and being configured to connect the exhaust air discharge side with the defrost air discharge side thereof for conveying defrost air to said defrost air discharge side from said exhaust air discharge side,

and

a damper component, said damper component being displaceable between a ventilation configuration for a ventilation cycle

wherein said defrost air path means is closed off and said fresh air intake side and said exhaust air discharge side are open,

and a defrost configuration for a defrost cycle

wherein said fresh air intake side and said exhaust air discharge side are closed off and said defrost air path means is open,

and wherein

during a ventilation cycle, when said damper component is in said ventilation configuration,

fresh air is able to flow through said fresh air path means and exhaust air is able to flow through said exhaust air path means,

and

during a defrost cycle, when said damper component is in said defrost configuration,

defrost air taken from the building, is able to circulate, for delivery back into the building, through said exhaust air intake side, through said second air stream path, then through said defrost air path means, and through said defrost air

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discharge side.

15. A defrostable ventilation apparatus, for exchanging air between the interior and exterior of a building, for transferring water moisture and sensible heat between exhaust air taken from the building and fresh air taken from the exterior ambient air for delivery to the building, and wherein air from the interior of the building is used as defrost air to defrost the ventilation apparatus, said ventilation apparatus having fresh air path means having a fresh air intake side and a fresh air discharge side, exhaust air path means having an exhaust air intake side and an exhaust air discharge side, a rotary exchanger wheel for transfer of water moisture and sensible heat between said exhaust air and said fresh air, said exchanger wheel being configured and rotatably disposed so as to define a first air stream path and a second air stream path, said first air stream path defining a portion of said fresh air path means between the fresh air intake side and the fresh air discharge side thereof and said second air stream path defining a portion of said exhaust air path means between the exhaust air intake side and the exhaust air discharge side thereof, and a rotation component for inducing rotation of said exchanger wheel through said fresh air path means and said exhaust air path means, characterized in that said apparatus comprises defrost air path means for providing an air path by-passing said first air steam path, said defrost air path means being configured to connect the exhaust air discharge side with

the fresh air discharge side for conveying defrost air to said fresh air discharge side from said exhaust air discharge side,

and

a damper component, said damper component being displaceable between a ventilation configuration for a ventilation cycle

wherein said defrost air path means is closed off and said fresh air intake side and exhaust air discharge side are open,

and a defrost configuration for a defrost cycle

wherein said fresh air intake side and said exhaust air discharge side are closed off, and said defrost air path means is open,

and wherein

during a ventilation cycle, when said damper component is in said ventilation configuration,

fresh air is able to flow through said fresh air path means and exhaust air is able to flow through said exhaust air path means,

and

during a defrost cycle, when said damper component is in said defrost configuration,

defrost air taken from the building, is able to circulate, for delivery back into the building, through said exhaust air intake side, through said second air stream path, then through said defrost air path means, and through said fresh air discharge side.

16. A ventilation apparatus, for exchanging air between the interior and exterior of a building, and for transferring, a member of the group comprising i) sensible heat and

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Figure 1. The structure of the proposed model. The model consists of three main parts: a feature extraction module, a classification module, and a fusion module. The feature extraction module uses a combination of a Convolutional Neural Network (CNN) and a Recurrent Neural Network (RNN) to process the input data. The classification module uses a Support Vector Machine (SVM) to classify the extracted features. The fusion module combines the results of the classification module with the input data to produce the final output.

exhaust air path means having an exhaust air intake side and an exhaust air discharge side,

said first air stream path defining a portion of the fresh air path means between the fresh air intake side and the fresh air discharge side thereof and said second air stream path defining a portion of said exhaust air path means between the exhaust air intake side and the exhaust air discharge side thereof,

first, second, third and fourth static pressure taps,

said third and fourth static pressure taps being configured and disposed for the determination of a second static pressure difference therebetween in said exhaust air

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18. A ventilation apparatus as defined in claim 17 wherein said first adjustable damper component is disposed on the fresh air discharge side of said fresh air path means, and

said second adjustable damper component is disposed on the exhaust air intake side of said exhaust air path means.

20. A ventilation apparatus as defined in claim 16 wherein said apparatus includes a fan component for forcing air to pass through said first and second air stream paths.

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is configured as a constant flow ventilation apparatus.

22. A ventilation apparatus as defined in claim 16 wherein said exchanger comprises a rotary exchanger wheel for exchanging sensible heat.

23. A ventilation apparatus as defined in claim 16 wherein said exchanger comprises a rotary exchanger wheel for exchanging sensible heat and water moisture.

24. A ventilation apparatus as defined in claim 16 wherein said exchanger element comprises a sensible heat exchanger and comprises air-to-air heat exchanging walls between said first and second air stream paths.

25. A ventilation apparatus as defined in claim 24 wherein said sensible heat exchanger is of a rectangular parallelepiped shape, the first and second air paths thereof are disposed at right angles to each other and said sensible heat exchanger element is so disposed such that the first and second air paths are diagonally oriented so that they are self draining.

26. A ventilation apparatus as defined in claim 16 wherein said fresh air path means, said exhaust air path means, and said ^{heat}exchanger means are disposed in a cabinet, wherein said fresh air intake side, said exhaust air discharge side, said fresh air discharge side and said exhaust air intake side each includes one respective air opening in a wall of said cabinet, wherein said first and second pressure tap means each comprise a pressure sampling aperture defined by a wall of said fresh air path means

and wherein said third and fourth pressure tap means each comprise a pressure sampling apertures defined by a wall of said exhaust air path means.

27. A ventilation apparatus as defined in claim 26 wherein said fresh air path means comprises a wall of said cabinet which defines said apertures of said first and second pressure tap means, wherein said exhaust air path means comprises a wall of said cabinet which defines said apertures of said third and fourth pressure tap means.

28. A ventilation apparatus as defined in claim 27 wherein said apparatus comprises a first adjustable damper component for adjusting air flow through said fresh air path means, and a second adjustable damper component for adjusting air flow through said exhaust air path means.

29. A ventilation apparatus as defined in claim 28 wherein said first adjustable damper component is disposed on the fresh air discharge side of said fresh air path means, and said second adjustable damper component is disposed on the exhaust air intake side of said exhaust air path means.

30. A ventilation apparatus as defined in claim 29 wherein said exchanger means comprises a rotary exchanger wheel.

determining a first static pressure difference in said fresh air path means, said first static pressure difference being determined with respect to first and second static pressure sampling locations, said first air stream path being disposed between said first and second static pressure sampling locations,

determining a second static pressure difference in said exhaust air path means, said second static pressure difference being determined with respect to third and fourth static pressure sampling locations, said second air stream path being disposed between said third and fourth static pressure sampling locations,

comparing predetermined air flow values represented by each of said so obtained first and second static pressure differences so as to determine if said predetermined fresh air and exhaust air flow values are at least substantially the same.

33. A method as defined in claim 32, wherein said apparatus includes
a first adjustable damper component for adjusting air flow through said fresh air path means, and
a second adjustable damper component for adjusting air flow through said exhaust air path means.

34. A method as defined in claim 33, said method including manipulating at least one of said first and second damper components until said so obtained first and second static pressure differences are each set at a value whereby each static pressure difference represents a respective predetermined air flow value which is at least

substantially the same as the other.

35. A ventilation apparatus, for exchanging air between the interior and exterior of a building, and for transferring water moisture and sensible heat between exhaust air taken from the building and fresh air taken from the exterior ambient air for delivery to the building,

said ventilation apparatus comprising

fresh air path means having a fresh air intake side and a fresh air discharge side,

exhaust air path means having an exhaust air intake side and an exhaust air discharge side,

an exchanger comprising

a desiccant exchanger element for transfer of water moisture and sensible heat between said exhaust air and said fresh air,

and

a sensible heat exchanger element for transfer of sensible heat between said exhaust air and said fresh air,

said desiccant exchanger element comprising a rotary exchanger wheel configured and rotatably disposed so as to define a second air stream path and a third air stream path,

said second air stream path defining a portion of said fresh air path means and

said third air stream path defining a portion of said exhaust air path means,

said sensible heat exchanger element comprising

a first air path defining a portion of said fresh air path means and a fourth air

path defining a portion of said exhaust air path means,

said fresh air path means and said exhaust air path means being disposed and

configured such that during a ventilation cycle,

exhaust air entering the exhaust air intake side flows through said third air stream path and then through said fourth air stream path and

fresh entering said the fresh air intake side flows through said first air stream path and then through said second air stream path,

said ventilation apparatus including a rotation component for inducing rotation of said exchanger wheel through said fresh air path means and said exhaust air path means.

36. A ventilation apparatus as defined in claim 35 wherein said sensible heat exchanger element comprises air-to-air heat exchanging walls between said first and fourth air paths.

37. A ventilation apparatus as defined in claim 36 wherein said sensible heat exchanger element is of a rectangular parallelepiped shape, the first and fourth air paths thereof are disposed at right angles to each other and said sensible heat exchanger element is so disposed such that the first and fourth air paths are diagonally oriented so that they are self draining.

38. A ventilation apparatus as defined in claim 35 wherein said sensible heat exchanger element is a rotary sensible heat exchanger wheel configured and rotatably disposed so as to define said first and fourth air stream paths and said apparatus includes a rotation component for inducing rotation of said sensible heat exchanger wheel through said fresh air path means and said exhaust air path means.

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a sensible heat exchanger element for transfer of sensible heat between
said exhaust air and said fresh air,
said desiccant exchanger element comprising a rotary exchanger wheel configured and
rotatably disposed so as to define a second air stream path and a third air stream path,
said second air stream path defining a portion of said fresh air path means and
said third air stream path defining a portion of said exhaust air path means,
said sensible heat exchanger element comprising

a first air path defining a portion of said fresh air path means and a fourth air path defining a portion of said exhaust air path means,

said first and second air stream paths defining respective portions of said fresh air path means between the intake and discharge sides of said fresh air path means,

said third and fourth air stream paths defining respective portions of said exhaust air path means between the intake and discharge sides of said exhaust air path means,

said fresh air path means and said exhaust air path means being disposed and configured such that during a ventilation cycle,

exhaust air entering the exhaust air intake side flows through said third air stream path and then through said fourth air stream path and fresh air entering said the fresh air intake side flows through said first air stream path and then through said second air stream path,

said ventilation apparatus including

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a damper component, said damper component being displaceable between a ventilation configuration for a ventilation cycle

wherein said defrost air path means is closed off and said fresh air intake side and exhaust air discharge side are open,

and wherein

fresh air is able to flow through said fresh air path means and exhaust air is able to flow through said exhaust air path means,

during a defrost cycle, when said damper component is in said defrost configuration, defrost air taken from the building, is able to circulate, for delivery back into the building, through said exhaust air intake side, through said third air stream path, through said fourth air stream path, then through said defrost air path means,

through said first air stream path, through said second air stream path and through said fresh air discharge side.

41. A ventilation apparatus as defined in claim 40 including a defrost rotation component for inducing, during a defrost cycle, said rotary exchanger wheel to rotate at a rotational speed of from 0 to 2 rpm.

42. A ventilation apparatus as defined in claim 40 including a component for stopping, during a defrost cycle, said rotary exchanger wheel from rotating.

43. A ventilation apparatus as defined in claim 42 wherein said rotation component comprises an electric motor and said component for stopping the rotation of said exchanger wheel comprises an electric switch configured so as to be able to de-energize said motor during a defrost cycle.

44. A ventilation apparatus as defined in claim 40 wherein said sensible heat exchanger element comprises air-to-air heat exchanging walls between said first and fourth air paths.

45. A ventilation apparatus as defined in claim 44 wherein said sensible heat exchanger element is of a rectangular parallelepiped shape, the first and fourth air paths thereof are disposed at right angles to each other and said sensible heat exchanger element is so disposed such that the first and fourth air paths are diagonally oriented so that they are self draining.

during a defrost cycle, when said first and second damper components are in said respective defrost configurations,

defrost air taken from the building, is able to circulate, for delivery back into the building, through said exhaust air intake side, through said second air stream path, then through said defrost air path means, through said first air stream path, and through said fresh air discharge side.

wherein said fresh air path means, said exhaust air path means, said rotary exchanger wheel, and said defrost air path means, are disposed in a cabinet,

wherein said fresh air intake side, said exhaust air discharge side, said fresh air discharge side and said exhaust air intake side each includes one respective air opening in an outer wall of said cabinet,

wherein a partition wall in said cabinet separates said exhaust air discharge side with said fresh air intake side,

and

wherein said defrost air path means comprises an opening in said partition wall.

50. A ventilation apparatus as defined in claim 49 wherein said apparatus includes fan means mounted in said cabinet for moving fresh air through said fresh air path means and for moving exhaust air through said exhaust air path means, said fan means comprising one motor and two blower wheels operatively connected thereto, said fresh air path means including one said blower wheel and said exhaust path means including the other said blower wheel.

51. A defrostable ventilation apparatus, for exchanging air between the interior and exterior of a building, for transferring water moisture and sensible heat between exhaust air taken from the building and fresh air taken from the exterior ambient air for delivery to the building, and wherein air from the interior of the building is used as defrost air to defrost the ventilation apparatus,
said ventilation apparatus comprising
fresh air path means having a fresh air intake side and a fresh air discharge side,
exhaust air path means having an exhaust air intake side and an exhaust air discharge side,
an exchanger comprising

a desiccant exchanger element for transfer of water moisture and sensible heat between said exhaust air and said fresh air,

and

a sensible heat exchanger element for transfer of sensible heat between said exhaust air and said fresh air,

said desiccant exchanger element comprising a rotary exchanger wheel configured and rotatably disposed so as to define a second air stream path and a third air stream path,

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said second air stream path defining a portion of said fresh air path means and
said third air stream path defining a portion of said exhaust air path means,
said sensible heat exchanger element comprising

a first air path defining a portion of said fresh air path means and a fourth air
path defining a portion of said exhaust air path means,
said first and second air stream paths defining respective portions of said fresh air path
means between the intake and discharge sides of said fresh air path means,
said third and fourth air stream paths defining respective portions of said exhaust air
path means between the intake and discharge sides of said exhaust air path means,
said fresh air path means and said exhaust air path means being disposed and
configured such that during a ventilation cycle,

exhaust air entering the exhaust air intake side flows through said third air
stream path and then through said fourth air stream path and
fresh entering said the fresh air intake side flows through said first air stream
path and then through said second air stream path,
said ventilation apparatus including

a rotation component for inducing rotation of said exchanger wheel through said fresh
air path means and said exhaust air path means,

defrost air path means for providing an air path by-passing said first air steam path, said
defrost air path means comprising a defrost air discharge side and being configured to
connect the exhaust air discharge side with the defrost air discharge side thereof for
conveying defrost air to said defrost air discharge side from said exhaust air discharge

side,

and

a damper component, said damper component being displaceable between a ventilation configuration for a ventilation cycle

wherein said defrost air path means is closed off and said fresh air intake side and said exhaust air discharge side are open,

and a defrost configuration for a defrost cycle

wherein said fresh air intake side and said exhaust air discharge side are closed off and said defrost air path means is open,

and wherein

during a ventilation cycle, when said damper component is in said ventilation configuration,

fresh air is able to flow through said fresh air path means and exhaust air is able to flow through said exhaust air path means,

and

during a defrost cycle, when said damper component is in said defrost configuration, defrost air taken from the building, is able to circulate, for delivery back into the building, through said exhaust air intake side, through said second air stream path, then through said defrost air path means, and through said defrost air discharge side.

52. A defrostable ventilation apparatus, for exchanging air between the interior and exterior of a building, for transferring water moisture and sensible heat between exhaust air taken from the building and fresh air taken from the exterior ambient air for

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fresh entering said the fresh air intake side flows through said first air stream path and then through said second air stream path,

a rotation component for inducing rotation of said exchanger wheel through said fresh air path means and said exhaust air path means,

and

wherein said defrost air path means is closed off and said fresh air intake side and exhaust air discharge side are open,

wherein said fresh air intake side and said exhaust air discharge side are closed off, and said defrost air path means is open,

during a ventilation cycle, when said damper component is in said ventilation

configuration,

fresh air is able to flow through said fresh air path means and exhaust air is able to flow through said exhaust air path means,

and

during a defrost cycle, when said damper component is in said defrost configuration, defrost air taken from the building, is able to circulate, for delivery back into the building, through said exhaust air intake side, through said second air stream path, then through said defrost air path means, and through said fresh air discharge side.

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